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Application of Value Engineering in Construction Projects

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Abstract - *Application of value engineering can be applied to various industries. In construction industries to apply value engineering is very difficult and to deal with it. For application of value engineering, Various techniques is applied to construction field. This technique helps in construction for low cost and high efficiency. Value engineering is tool that balance between cost and function associate with it without compromising its quality in time. It is an intensive, interdisciplinary problem solving activity that focuses on improving the value of the functions that are required to accomplish the goal, or objective of any product, process, service, or organization. Value engineering is one of the best technique to identify unnecessary cost and eliminate it in all sectors. In VE hidden cost can also identify and eliminated it without affecting quality. This paper discussed the techniques involved in concept of Value Engineering and the effective implementation in Cement Concrete road sector by applying Pareto's analysis and after that VE job plan is applied to that items which are evaluated by Pareto's law.*

Key Words: Construction Industry, Cost, Function, Job Plan, Pareto analysis, Value Engineering

1. INTRODUCTION

Saving money and, at the same time, providing better value is a concept that everyone supports. The benefits of spreading our investment rupees, building more for less money, increasing efficiency and cutting down our dependency on energy- intensive building and plant facilities need to be recognized today and pursued in the future.

Value engineering (VE) is a "systematic method to improve the "value" of goods or products and services by using an examination of function". Value, as defined, is the ratio of function to cost.

Value can therefore be increased by either improving the function or reducing the cost. It is a primary tenet of value engineering that basic functions be preserved and not be reduced as a consequence of pursuing value improvements. It is conducted by a multidisciplinary team composed of experienced and specialized professionals. The VE team is independent of the design team, but its members must have experience in the particular field of the project in question.

Value engineering is a proven management technique using a systematized approach to seek out the best functional balance between the cost, reliability and performance of a product or project. The program seeks to improve the management capability of people and promote progressive change by identifying and removing unnecessary cost. Generally, pareto analysis is first done by the value engineering team before applying value engineering job plan because Pareto analysis identifies the activity which need significant analyzed by value engineering team.

2. OBJECTIVES OF STUDY

Objectives of the study are as below:

1. To find out cost of component and its functions and identify the high-cost functions.
2. To eliminate the unnecessary functions.
3. To find out different alternatives with same or more functions provision.
4. To reduce project cost.

3. ADVANTAGES OF VE

Following are the advantages of VE:

1. Higher productivity (Simplified manufacturing)
2. Cost reduction
3. Improved predictability
4. Reduction in lead time
5. Improved parts or Bought out Components (BOC) availability.
6. Better Reliability
7. Better performance
8. Weight reduction
9. Better quality
10. Improved logistics
11. Better packaging
12. Improved maintainability, Better appearance
13. Optimization of project cost, Higher market share in business.
14. The decision to make or buy
15. Simpler design (civil, structural, mechanical, etc.

4. RESEARCH METHODOLOGY

The study aims to identify the application of VE job plan on different road items. Different literatures related to this research are reviewed, and in order to see Road construction practices, the following research methodology is implemented which is shown in figure.

The data for case study is obtained from RDD department Surat. The site survey is conducted for study of application of value engineering. Methodology of VE is shown as in figure

Generally, for application of VE different stages of the project such as design stage, structural stage, construction stage is analyzed.

This methodology includes job plan which is systematic and organized approach. For this paper six phase job plan is carried out which is listed below:

1. Information phase
2. Functional analysis
3. Creative phase
4. Evaluation phase
5. Development phase
6. Reporting phase

The details description of following phases are:

1. Information phase:
   - In this phase, background details of project are carried out. Information regarding problem is collected from various aspect of project for solving problems.
   - The main aim of this phase is to collect as much as possible information from the trusted source and assisting the problem.

2. Functional analysis:
   - In this phase, the cost associated with each function is identified. The main aim of this phase is to know the balance between the function and cost.
   - Functional analysis is a border and more comprehensive understanding of a project by team discussion.

3. Creative phase:
   - In this phase, VE team lists creative idea are generated from a functional analysis with the aim of obtaining different alternatives through brain storming and creative proposals.
   - This is the most challenging task for a VE team members and participants. All generated ideas are screened in a next phase of the study.

4. Evaluation phase:
   - The idea generated from the creative phase are screened and evaluated by the VE team members. The idea showing that the function of the activity remains same with a cost saving.
   - In this phase, ranking method is applied to generated alternatives to find out most appropriate alternative for a particular project.
5. Development phase:
   - The VE team researches the selected idea and prepare a cost estimates, its description to support the recommendation.
   - All recommendations are described with a detailed design, concept, technical information and cost summaries.
   - The developed ideas are clearly written so that project stake holders can understand how it benefits the project and any negative factors associated with the idea.

6. Reporting phase:
   - This is the final phase of VE. In this phase, VE team prepare a presentation on a proposal which are generated during the development phase with a proper documentation.
   - This phase outline anticipated implementation schedule.

5. DATA ANALYSIS AND RESULT

Case study of cement concrete road has been taken to understand application of Value Engineering.

In this Master format and Uniformat was prepared. After that next step is to applied Pareto's law of 20/80 which comes through ranking of their costs in descending order. It says that normally 20% of functions constitutes around 80% of the cost.

Table -1: Background information of C.C. road

Name of Road	C.C. Road from VIP to Ram Chowk, Surat, Gujarat
Type of road	Rigid pavement
Width of Road	36m
Total cost	20,81,19,374 Rs.

All the Documents related to the Subject under study like Cost Estimates, Design Drawings Provision of Budget etc. were collected from best sources.

Cost Model was prepared after studying its estimates and presented to the V.E team for various V.E phases requirements.

Table 2: Cost Estimate of C.C. Road (Source: RDD Department, SMC)

Sr. No	Description	% of Total	Cost (Rs.)
Section (A) Cement Concrete Road			
1	Site clearance	4.70	9,790,720
2	Earthworks	6.14	12,798,896
3	Drainage & Protective works	6.22	12,948,082
4	Cement Concrete Pavement	46.24	96,250,716
	Total of Section (A)	63.32	131,788,415
Section. (B) Bituminous Road			
5	Bituminous Pavement Work	8.93	18,585,530
	Total of Section (B)	8.93	18,585,830
Section. (C) Footpath, Parking & Seating			
6	Kerb Stone	7.7	16,163,200
7	P.C.C Pano & Paver block	8.30	17,284,872
8	Street Furniture	1.31	2,731,283
	Total of Section (C)	17.38	36,179,355
Section. (D) Road signages			
9	Pavement Marking	0.57	1,197,278
10	Road Signage	1.85	3,870,117
	Total of Section (D)	2.43	5,067,395
Section. (E) Electrical works			
11	Street Light & Electrification Work	5.7	11,881,393
	Total of Section (E)	5.70	11,881,393
Section. (F) Horticulture			
12	Trees	1.8	3,842,665
13	Ground Covers	0.37	774,317
	Total of Section (F)	2.22	4,616,983
	TOTAL of (A)+(B)+(C)+(D)+(E)+(F)	100	20,81,19,374

Based on Table 2, the area of value engineering study is controlled by following items which is listed in following table.

Table 3: Uniformat table

Sr no.	Item Name	% of total
1	Cement concrete Road	46.24%
2	Bituminous Pavement work	8.93%
3	Paver block Work	8.30%
	Total	64%

From the above table we can say that 3 items out of 13 items forms around 64% of the total cost. This means 23.07% functions forms around 64% of the total cost which is very close to Pareto's Law. So area of value engineering is controlled by this 3 items. After knowing area of value engineering, VE job plan methodology is applied to that items which is identified in Pareto analysis.

- In Information phase, facts from the best source is gathered and recheck all data.
- After that in function analysis, function and cost associate with each of the 3 items are identified.
- In Idea listing phase, alternative materials are identified such as use of Copper slag waste up to 40% in DLC and PQC work or use of recycled material etc. are generated.
- In Evaluation phase ranking of the ideas are done using decision matrix. It is done by assigning relative weights to each criterion and then deriving an overall measure of effectiveness. It can be done using a five-point scale and making paired comparison of all ideas.
- In Development phase, Select/Rank the best alternative idea for further development.

6. CONCLUSIONS

After applying VE job plan to Pareto's analysis, following are the conclusions made by VE team members,

- Value engineering can be applied during any stage of construction. But it greater result can be achieved in conceptual and development phase.
- If early application of VE is applied, more benefit will be achieved. But in cost saving techniques, quality of product or design must never be compromised
- In this study, the VE is used for the cost reduction of construction of C.C. road without the change in the product design & its value A proper decision matrix is prepared for choosing the appropriate alternative from the feasible choices available and following conclusions are drawn:
    - The total cost of proposed value engineering proposal can be reduced from RS. 20,81,19,374/- to RS. 20,49,32,003 /-. So total cost saving of the project is RS. 31,87,371/-
    - With the use of VE, Waste concrete from divider can be also utilized in subgrade.
    - Industrial waste copper slag utilized up to 40% by replacement with sand in DLC and PQC work
- The other factors also affect indirectly to project cost and time such as,
    - Location of site should be within 2KM from the plant location is mostly preferable.
    - Experienced surveyor is one of the major success factor for the construction of road project.
    - Available Machinery.

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